2011

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Original Publication Citation

Nzala, S. H., Siziya, S., Babaniyi, O., Songolo, P., Muula, A. S., & Rudatsikira, E. (2011). Demographic, cultural and environmental factors associated with frequency and severity of malnutrition among Zambian children less than five years of age. *Journal of Public Health and Epidemiology*, *3*(8), 362-370. https://academicjournals.org/journal/JPHE/article-abstract/B12E24F1653

Journal of Public Health and Epidemiology Vol. 3(8), pp. 362-370, August 2011
Available online at http://www.academicjournals.org/jphe
ISSN 2141-2316 ©2011 Academic Journals

Full Length Research Paper

Demographic, cultural and environmental factors associated with frequency and severity of malnutrition among Zambian children less than five years of age

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Accepted 15 June, 2011

Under-nutrition prevents growth and development in children and is the leading factor to illness and death among children less than five years of age in developing countries. The objective of the study was to determine associations of demographic, cultural and environmental factors with frequency and severity of malnutrition among children less than five years of age in Zambia. We used data from the Zambia multiple indicator cluster survey (MICS) from years of 1999 to 2000. Altogether 6,142 children participated in the survey. The prevalence rates for being "underweight", "stunted" and "wasted" were 17.6, 37.5 and 4.1%, respectively. Compared to children from Western province, those from Luapula, Northern, and North-West provinces were more likely to be underweight. Children from Lusaka, Southern, Copperbelt, Eastern, and Central provinces were less likely to be underweight compared to those from Western province. Other factors associated with children malnutrition included sex, low educational level of householder and mother, poverty, vaccination status and type of toilet. The data acquired in this study may be used in developing interventions to prevent and mitigate children malnutrition. Special attention may have to be given to the provinces where children are more likely to suffer from malnutrition.

Key words: Malnutrition, underweight, stunted, wasted, children under 5 years of age, Zambia.

INTRODUCTION

The World Health Organization (WHO) estimates that 60% of all deaths occurring among children aged less than five years in developing countries can be attributed to malnutrition. Nearly 50.6 million of children less than 5 years are malnourished, and almost 90% of these children are from developing countries.

The adverse effects of under-nutrition span through the lifetime of the children who survive into adolescence and adulthood. Under-nutrition adversely affects children's cognitive performance with consequent under-performance in school. Stunted women are likely to have obstetric complications such as obstructed labour (Ampofo et al., 1990). Being stunted in childhood may be associated with cardiovascular morbidity (Stein et al., 2005; Yang et al., 2008). In Africa, about 50% of children aged 12 to 15 months are underweight and more than one third of children less than five years are stunted (Benson and Shekar, 2006). Such high prevalence of malnutrition leads to high mortality and morbidity, poor school attainment, and low productivity later in life (Alderman et al., 2003).

Some other complications of malnutrition include: Marasmus (James, 1977), kwashiorkor, diarrhea, anemia, sepsis (Bernal et al., 2008), hypothermia (Talbert et al., 2009), pseudomyopathic motor deficit (Renault

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and Quesada, 1993) and lactose intolerance (Nyeko et al., 2010)

Previous studies on malnutrition in children have been limited either to limited region(s)/ district(s) of a given country (Charlton et al., 2009) or focused on children malnutrition and HIV (Filteau et al., 2011; Hughes et al., 2009), therapeutic care of severely malnourished children (Bachmann, 2009; Amadi et al., 2005), and nutrition and health education (Sherman and Muehlhoff, 2007). A recent study has suggested that children nutrition is improving in Eastern and Southern Africa (Mason et al., 2010). The aim of this study was to examine the determinants for child malnutrition in a nationally representative sample of Zambian children less than five years of age; so our study is the first one to survey some risk factors of malnutrition on large part of a country. The data acquired from this can be used in programming interventions to prevent and mitigate children malnutrition.

MATERIALS AND METHODS

The Zambia multiple indicator cluster survey (MICS) setting

The Zambia MICS was a national survey which recruited participants from all the nine provinces of the country. Administratively, Zambia is divided into nine provinces, namely: Copperbelt, Luapula, Northern (from the northern part of the country), Central, Lusaka (from the central part of the country), Eastern, North-Western, Southern and Western (from their respective geographical locations of the country). Lusaka (the capital city) and Copperbelt (home to copper mines) are predominantly urban provinces while the rest of the provinces are predominantly rural. Western province is on a flood plain. Provinces in the northern part of the country, including North-Western and part of Central are mountainous (with about half of the area lying at more than 1200 m above sea level) and receive the highest average annual rainfall ranging from 1100 to over 1400 mm. The southern and eastern parts of the country receive less annual rainfall ranging from 600 to 1100 mm. These provinces are further divided into a total of 72 districts. Some districts in Western, Southern and eastern provinces are prone to drought as they receive less rainfall. The survey used a two-stage stratified probability schedule. Sampled clusters were selected proportional to the size of provinces. Each province was treated as an independent stratum, stratified by urban and rural strata.

In the first stage of sampling, the primary sampled units [Standard enumeration areas (SEA)] were based on the probability proportional to the size in each district. The second stage was the selection of households within the sampled SEAs. A total of three hundred sixty SEAs were selected from a total of 13,000 SEAs in Zambia. Twenty five households in urban areas and 20 households in rural areas were selected from each sampled SEA by the systematic sampling method. A total of 8,000 households were eventually drawn.

The questionnaire

The questionnaire used by the Zambia MICS was based on the MICS model questionnaire which had a few modifications for the country in that it for used one unified questionnaire that comprises households', women and children's questionnaires. The questionnaire was pre-tested in July 1999. The pre-test was primarily concerned with the flow of questions, translation during interviews and the actual wording of the questions. Based on the results of the pretest, modifications were made to the wording and better local language translation formats. Complete instructions were given to the research assistants to guide them to which section of the questionnaire was appropriate to each category of respondents.

Based on the factors associated with malnutrition, we selected the following variables from the questionnaires for analysis: Age of child (less than 5 years), sex of child, sex of householder, area of residence (rural or urban), region (province), education level of householder and mother (none, primary, secondary or higher), wealth index (poorest, second, middle, fourth or richest), main source of water (piped water, borehole with pump, protected well/spring, unprotected well/spring, or pond/river/stream), type of toilet facility (flush, pour flush, improved pit latrine, traditional pit latrine, or none/bush/field), treatment of children's stool (always used toilet, threw in toilet, threw outside yard, or buried in the yard), vaccination status (complete or incomplete), diarrhea in the past 7 days (yes or no), acute respiratory infection in past 7 days (yes or no).

Sample characteristics and response rate

A total of 8,000 households were selected for the MICS sample. When a household refused to be interviewed or could not be found because of any cause, the household was replaced. The replacement was to improve the response rate. However, there were cases when even the replaced household did not cooperate.
A total of 6,397 children less than five years of age were listed in the household questionnaire. Of these, questionnaires were completed for 6,217 children less than five years with a response rate of 97%

Definition of "underweight", "stunted" and "wasted"

Weight for age is a measure of both acute and chronic malnutrition. Children whose weight for age is more than two standard deviations below the median of the reference population are considered "moderately or severely underweight". Furthermore, those children whose weight for age is more than three standard deviations below the median are classified as "severely underweight".
Height for age is a measure of linear growth. Children whose height for age is more than two standard deviations below the median of the reference population are considered short for their age and are classified as "moderately or severely stunted". Those whose height for age is more than three standard deviations below the median are classified as "severely stunted". To be stunted is a reflection of chronic malnutrition as a result of failure to receive adequate nutrition over a long period and includes recurrent or chronic illness.
Finally, children whose weight for height is more than two standard deviations below the median of the reference population are classified as "moderately or severely wasted" while those who fall more than three standard deviations below the median are "severely wasted". Wasting is usually the result of a recent energy intake deficiency.

Computation of wealth index

Wealth was defined based on household assets such as radio, bicycle, car, television, type of roofing and floor. Each asset was assigned a standardized score. These scores were then summed

and households were ranked into five quintiles (Filmer and Pritchett, 1999).

Data analysis

Acquired data were analysed using SPSS version 11.5 (SPSS, Chicago Illinois, United States). We had three outcomes of interest that is, wasted, stunted and underweight. The following variables were assessed for their associations with each of these outcomes: the child's age and sex, sex of householder, household's wealth status, educational level of householder and mother, sanitation, access to potable water, place of residence (rural versus urban and province). The results are reported as unadjusted odds ratios (from bivariate analyses) and adjusted odds ratios (from multivariate analysis) with their 95% confidence intervals.

RESULTS

Sample description

Altogether 6,142 children participated in the survey of whom 51.8% were males, and the median age was 27 (Q_1 = 13, Q_3 = 42) months. A total of 75 children had no information on the nutritional status. About two-thirds (65.5%) of the children were reported to reside in rural areas. Overall, 15.1 and 23.0% of householders and mothers, respectively, had never been educated. About 1 to 5 (20.7%) of the participants belonged to the poorest quintile of the wealth index. The sample comprised 14.4% children who belonged to female headed households. Overall, 40.9% of children were fully immunized. Diarrhoea and acute respiratory infection were reported in 19.0 and 2.3% of the children, respectively. The prevalence rates for "underweight", "stunted" and "wasted" were 17.6, 37.5, and 4.1%, respectively. Further description of the sample is presented in Table 1.

Correlations in malnutrition

Table 2 presents results in bivariate logistic regression analysis. This analysis showed that older ages were associated with being stunted and underweight while younger ages were associated with wasting. Male gender, living in rural area, low educational levels of householders and mothers, and immunization status were associated with all three types of malnutrition.

Results from the multivariate analysis (Table 3) indicated that male gender, low educational level of householder and mother, poverty, vaccination status, diarrhoea in past seven days, and absence of toilet or use of traditional pit latrine were positively associated with all three types of malnutrition. Place of residence (province and rural/urban) were associated with malnutrition. Compared to urban children, rural children were more likely to be wasted, but less likely to be stunted or underweight. Children from Luapula province were 2.18 (95%CI [2.15, 2.21] times more likely to be underweight compared to children in Western province. Compared to children from Western province, children from Luapula, Lusaka, and North-Western provinces were 1.79 (95%CI [1.75, 1.84]), 1.67 (95%CI [1.63, 1.72]) and 1.92 (95%CI [1.86, 1.98]) times more likely to be wasted, respectively. Meanwhile, children from Southern province were 60% (AOR = 0.40, 95%CI [0.39, 0.41]) less likely to be wasted compared to children from Western province.

Type of toilet facility was strongly associated with underweight and wasting in bivariate analyses. Meanwhile, in multivariate analysis, strong associations of type of toilet facility were only observed with wasting. Children in households that had "pour flush toilets" were 79% (AOR = 0.21, 95%CI [0.18, 0.24]) less likely to be wasted compared to children from households that had no toilet facility (used bush or field). Meanwhile, children in households that had improved pit latrines were 2.29 (95%CI [2.18, 2.40]) times more likely to be wasted compared to children from households that had no toilet facility.

DISCUSSION

In a study of children under the age of 5 years in Zambia, the multivariate logistic regression analysis showed that being underweight, stunted and wasted were positively associated with male gender. However, in a study of malnutrition among children younger than six years in three tribal communities in India, Kshatryia and Ghosh (2008) found that there was no sex difference in the prevalence of malnutrition. Similarly, in a study among the Fulani in Nigeria, Ekpo et al. (2008) reported a statistically non-significant higher prevalence of malnutrition among boys compared to girls. In some Zambian cultures, male toddlers may eat with their fathers. Eating with a father may mean fewer meals than a female child who is always with a mother and mother may pass on whatever she has herself throughout the day. Furthermore, more energy expenditure in boys because of playing more may be a cause for the higher prevalence of malnutrition in boys than girls.

In this study, older ages were associated with being stunted and underweight while younger ages were associated with being wasted. In a study of malnutrition among Ethiopian urban children, Getaneh et al. (1998) found that being stunted peaked in the fifth year. A higher frequency of "wasted" in younger ages suggests a recent under-nutrition; and a higher frequency of "stunted" and "underweight" in older ages is a sign of chronic under-nutrition; suggesting starvation and under-nutrition for many years which have not be solved.

We found that children malnutrition was associated with place of residence, vaccination status, and type of toilet. In this study, compared to urban children, rural children

Table 1. Socio-demographic description of the sample.

Factor	Total
	Median (Q_1, Q_3)
Age of child (months)	27 (13, 42)
	n* (%)**
Sex of child	
Male	3118 (51.8)
Female	3024 (48.2)
Sex of householder	
Male	5267 (85.6)
Female	875 (14.4)
Area of residence	
Rural	3246 (65.5)
Urban	2896 (34.5)
Region (province)	
Central	696 (10.8)
Copperbelt	852 (14.0)
Eastern	670 (15.3)
Luapula	572 (8.5)
Lusaka	866 (13.1)
Northern	720 (13.7)
North-Western	508 (4.9)
Southern	745 (13.1)
Western	513 (6.7)
Education level of householder	
None	577 (15.1)
Primary	1849 (47.2)
Secondary or higher	1853 (37.7)
Education level of mother	
None	1295 (23.0)
Primary	3243 (55.2)
Secondary or higher	1604 (21.8)
Wealth index (quintile)	
Poorest	1045 (20.7)
Second	1066 (20.0)
Middle	1212 (20.0)
Fourth	1484 (21.0)
Richest	1319 (18.4)

*Unweighed frequency, **Weighted percent.

were more likely to be wasted and less likely to be stunted and underweight. This is a reflection of the higher poverty levels in rural (83%) than urban (56%) areas (Central statistical Office (Zambia), 2003). Poverty in the Zambian context is defined as lack of access to income, entitlements for citizens to such things as freely determined consumption of goods and services, shelter and other basic needs of life (MOFNP, 2002). Children living in northern part of Zambia (Northern, Luapula and North-Western provinces) were more likely to be

Table 2. Correlates for malnutrition in bivariate analyses.

Factor	Unadjusted odds ratios (95% Confidence interval) [OR (95%CI)]		
	Underweight	**Stunted**	**Wasted**
Age of child (months)	1.01 (1.01, 1.01)	1.03 (1.03, 1.03)	0.99 (0.99, 0.99)
Sex of child			
Male	1.08 (1.08, 1.09)	1.06 (1.06, 1.07)	1.11 (1.10, 1.12)
Female	1	1	1
Sex of householder			
Male	0.90 (0.90, 0.91)	0.94 (0.94, 0.95)	1.00 (0.99, 1.01)
Female	1	1	1
Area of residence			
Rural	1.26 (1.25, 1.26)	1.10 (1.10, 1.11)	1.08 (1.07, 1.09)
Urban	1	1	1
Region (province)			
Central	0.76 (0.75, 0.77)	0.77 (0.76, 0.78)	0.63 (0.62, 0.65)
Copperbelt	0.64 (0.63, 0.65)	0.93 (0.92, 0.94)	0.61 (0.59, 0.62)
Eastern	0.89 (0.88, 0.90)	1.24 (1.23, 1.25)	0.93 (0.91, 0.95)
Luapula	1.81 (1.79, 1.83)	1.16 (1.15, 1.17)	1.86 (1.82, 1.89)
Lusaka	0.77 (0.76, 0.78)	0.79 (0.78, 0.79)	1.62 (1.58, 1.69)
Northern	1.78 (1.76, 1.79)	1.23 (1.22, 1.24)	1.36 (1.34, 1.39)
North-Western	1.09 (1.07, 1.11)	0.96 (0.95, 0.98)	1.73 (1.69, 1.78)
Southern	0.94 (0.93, 0.95)	1.01 (1.01, 1.02)	0.58 (0.57, 0.60)
Western	1	1	1
Education level of householder			
None	1.20 (1.19, 1.21)	1.18 (1.17, 1.19)	1.36 (1.34, 1.38)
Primary	1.13 (1.12, 1.13)	1.15 (1.14, 1.15)	0.92 (0.91, 0.93)
Secondary or higher	1	1	1
Education level of mother			
None	1.12 (1.11, 1.12)	1.14 (1.13, 1.15)	1.21 (1.20, 1.23)
Primary	1.15 (1.14, 1.16)	1.13 (1.13, 1.14)	0.97 (0.96, 0.98)
Secondary or higher	1	1	1
Wealth index (quintile)			
Poorest	1.32 (1.31, 1.33)	1.17 (1.16, 1.18)	0.89 (0.87, 0.90)
Second	1.12 (1.11, 1.12)	1.19 (1.18, 1.20)	0.84 (0.82, 0.85)
Middle	1.35 (1.34, 1.36)	1.16 (1.15, 1.17)	1.40 (1.38, 1.42)
Fourth	0.94 (0.94, 0.95)	0.85 (0.85, 0.86)	1.19 (1.17, 1.21)
Richest	1	1	1
Main source of water			
Piped water	0.68 (0.67, 0.68)	0.80 (0.79, 0.80)	1.00 (0.98, 1.01)
Borehole with pump	1.03 (1.02, 1.04)	1.02 (1.01, 1.03)	1.04 (1.02, 1.06)
Protected well/spring	0.96 (0.95, 0.97)	1.06 (1.05, 1.06)	0.77 (0.76, 0.79)
Unprotected well/spring	1.41 (1.40, 1.42)	1.14 (1.14, 1.15)	1.21 (1.19, 1.23)

Table 2. Contd.

Pond/river/stream	1	1	1
Type of toilet facility			
Flush	0.73 (0.71, 0.74)	0.95 (0.94, 0.96)	1.17 (1.12, 1.22)
Pour flush	0.49 (0.48, 0.51)	0.81 (0.79, 0.82)	0.14 (0.12, 0.16)
Improved pit latrine	1.05 (1.03, 1.08)	0.60 (0.59, 0.61)	2.60 (2.48, 2.73)
Traditional pit latrine	1.54 (1.52, 1.56)	1.41 (1.40, 1.42)	1.67 (1.61, 1.73)
None/bush/field	1	1	1
Treatment of children's stool			
Always used toilet	0.78 (0.77, 0.79)	0.96 (0.95, 0.97)	1.04 (1.02, 1.07)
Threw in toilet	0.99 (0.98, 0.99)	0.95 (0.94, 0.95)	1.20 (1.18, 1.22)
Threw outside yard	1.21 (1.20, 1.22)	1.19 (1.18, 1.20)	1.21 (1.19, 1.24)
Buried in the yard	1	1	1
Vaccination status			
Complete	1.30 (1.29, 1.30)	1.45 (1.44, 1.45)	1.06 (1.05, 1.06)
Incomplete	1	1	1
Diarrhoea in past 7 days			
Yes	1.24 (1.24, 1.25)	1.15 (1.14, 1.15)	1.36 (1.35, 1.37)
No	1	1	1
Acute respiratory infection in past 7 days			
Yes	0.98 (0.96, 0.99)	0.93 (0.92, 0.94)	1.14 (1.11, 1.17)
No	1	1	1

malnourished than those living in Western province. This difference between the provinces may belong to their altitude, poverty levels and secondary deficiency of some necessary micro- and macro-nutrients. The northern part of Zambia is mountainous and receives the highest annual rainfall. Regional differences in the prevalence of malnutrition have been reported elsewhere. In a study conducted in Nigeria, Ordinioha and Sawyer (2008) found that malnutrition was common in the desert region of Bhil compared to the non-desert regions of Dhodia and Kinnaura. They also reported a positive association between environmental degradation by oil spills in Nigeria and child malnutrition. Hein and Kam (2008) also reported that region of residence was significantly related to malnutrition in Vietnam. Vitolo et al. (2008) reported that stunting was associated with poor sanitation among children in southern Brazil.

Lower educational level of householder and mother were positively associated with all types of child malnutrition. These findings are consistent with previous reports from Ghana (Appoh and Krekling, 2005) and Egypt (Zottarelli et al., 2007). Hein and Kam (2008) also reported that the mother's level of education was significantly related to malnutrition in Vietnam. They also showed that the duration of exclusive breastfeeding was significantly associated to malnutrition. Mashal et al. (2008) reported that young maternal age, migration within the country and limited maternal autonomy were associated with children malnutrition in Afghanistan.

Limitations

Despite the strengths of the current study, which include the fact that the sample was nationally representative and a standard questionnaire was used for data collection; the present study has a number of limitations. As a cross sectional study, we cannot assign causation to any of the associated variables. Secondly, much of the data were self-reported. To the extent that the mothers and guardians of the children inaccurately reported, our results may be biased. We also did not assess all the potential factors that could explain the differences in prevalence of malnutrition. We also did not assess overall nutritional status based on laboratory assessments of nutrients. However, we believe underweight, stunted and

Table 3. Correlates for malnutrition in multivariate analysis.

Factor	Adjusted odds ratios (95% Confidence interval) [AOR (95%CI)]		
	Underweight	Stunted	Wasted
Age of child (months)	0.99 (0.99, 0.99)	1.01 (1.01, 1.01)	0.97 (0.97, 0.97)
Sex of child			
Male	1.14 (1.13, 1.15)	1.18 (1.17, 1.19)	1.21 (1.19, 1.23)
Female	1	1	1
Sex of householder			
Male	0.96 (0.94, 0.97)	1.07 (1.06, 1.09)	1.15 (1.12, 1.18)
Female	1	1	1
Area of residence			
Rural	0.94 (0.93, 0.95)	0.88 (0.87, 0.88)	1.18 (1.16, 1.20)
Urban	1	1	1
Region (province)			
Central	0.82 (0.81, 0.83)	0.83 (0.82, 0.84)	0.74 (0.72, 0.76)
Copperbelt	0.89 (0.87, 0.90)	1.12 (1.10, 1.13)	0.88 (0.86, 0.91)
Eastern	0.72 (0.71, 0.73)	1.26 (1.25, 1.27)	0.72 (0.70, 0.74)
Luapula	2.18 (2.15, 2.21)	1.21 (1.20, 1.23)	1.79 (1.75, 1.84)
Lusaka	0.86 (0.84, 0.87)	0.71 (0.70, 0.72)	1.67 (1.63, 1.72)
Northern	1.94 (1.92, 1.97)	1.18 (1.17, 1.20)	1.32 (1.29, 1.35)
North-western	1.19 (1.16, 1.21)	1.13 (1.11, 1.16)	1.92 (1.86, 1.98)
Southern	0.74 (0.73, 0.75)	0.79 (0.78, 0.80)	0.40 (0.39, 0.41)
Western	1	1	1
Education level of householder			
None	1.08 (1.07, 1.09)	1.10 (1.09, 1.11)	1.29 (1.27, 1.31)
Primary	1.04 (1.03, 1.04)	1.07 (1.07, 1.08)	0.89 (0.88, 0.90)
Secondary or higher	1	1	1
Education level of mother			
None	1.08 (1.07, 1.09)	1.08 (1.07, 1.09)	1.23 (1.21, 1.24)
Primary	1.08 (1.07, 1.08)	1.14 (1.13, 1.15)	0.94 (0.92, 0.95)
Secondary or higher	1	1	1
Wealth index (quintile)			
Poorest	1.21 (1.19, 1.23)	1.04 (1.02, 1.05)	1.01 (0.98, 1.04)
Second	1.01 (0.99, 1.02)	1.14 (1.13, 1.15)	0.95 (0.93, 0.98)
Middle	1.01 (0.99, 1.02)	1.09 (1.08, 1.10)	1.21 (1.18, 1.23)
Fourth	1.10 (1.01, 1.03)	0.78 (0.78, 0.79)	1.18 (1.16, 1.21)
Richest	1	1	1
Main source of water			
Piped water	0.95 (0.93, 0.97)	1.08 (1.06, 1.10)	1.32 (1.29, 1.36)
Borehole with pump	1.15 (1.13, 1.16)	0.96 (0.95, 0.97)	1.18 (1.15, 1.21)
Protected well/spring	0.95 (0.94, 0.97)	1.00 (0.99, 1.02)	0.76 (0.74, 0.78)
Unprotected well/spring	1.23 (1.21, 1.24)	1.03 (1.02, 1.04)	1.06 (1.04, 1.08)

Table 3. Cont

Pond/river/stream	1	1	1
Type of toilet facility			
Flush	0.93 (0.91, 0.95)	0.90 (0.89, 0.92)	1.47 (1.40, 1.54)
Pour flush	0.54 (0.52, 0.56)	0.72 (0.70, 0.73)	0.21 (0.18, 0.24)
Improved pit latrine	1.30 (1.26, 1.33)	0.72 (0.70, 0.74)	2.29 (2.18, 2.40)
Traditional pit latrine	1.16 (1.14, 1.18)	1.44 (1.42, 1.46)	1.11 (1.07, 1.16)
None/bush/field	1	1	1
Treatment of children's stool			
Always used toilet	0.93 (0.91, 0.95)	0.99 (0.98, 1.10)	1.08 (1.05, 1.10)
Threw in toilet	0.91 (0.90, 0.92)	0.95 (0.94, 0.96)	0.98 (0.96, 1.00)
Threw outside yard	1.05 (1.03, 1.06)	1.14 (1.13, 1.16)	1.35 (1.32, 1.38)
Buried in the yard	1	1	1
Vaccination status			
Complete	1.11 (1.10, 1.11)	1.15 (1.14, 1.15)	0.89 (0.88, 0.89)
Incomplete	1	1	1
Diarrhoea in past 7 days			
Yes	1.10 (1.09, 1.11)	1.08 (1.07, 1.08)	1.12 (1.11, 1.13)
No	1	1	1
Acute respiratory infection in past 7 days			
Yes	0.88 (0.87, 0.89)	0.85 (0.84, 0.86)	1.08 (1.05, 1.11)
No	1	1	1

wasted children were also likely to have had micronutrient deficiencies compared to their well-fed colleagues.

Conclusion

The high prevalence rates of children malnutrition in Zambia call for urgent efforts to prevent and mitigate children malnutrition by addressing the risk factors identified in this study. Special attention may have to be given to the provinces where children are more likely to suffer from malnutrition.

ACKNOWLEDGEMENTS

We thank the Food Security, Health and Nutrition Information and the Central Statistical Office Labour Division for collecting the data. The United Nations Children's Fund and the International Labour Organization provided funds for the survey. This study would not have been possible without the participants in the MICS of the years 1999 and 2000, to whom we are thankful.

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